"The Australasian Journal of Pharmacy." Vol. vi., No. 71 (November, 1891). *From the Editor.*

"Annual Progress Report of State Forest Administration in New South Wales for the Year 1890." *From the Director-General of Forests.*

PAPERS READ.

THE LAND MOLLUSCAN FAUNA OF BRITISH NEW GUINEA.

(Anatomical Supplement, continued from p. 115.)

By C. Hedley, F.L.S.

(Plates xxxviii.-xlii.)

Nanina hunsteini, Smith.

Jaw (pl. xxxviii., fig. 1) arched, smooth, with a slight median projection inferiorly, emarginate superiorly, ends rounded.

Radula (pl. xxxix., fig. 11) strap-shaped, three times as long as broad; formula 160 rows of 90 : 20 : 1 : 20 : 90; rows nearly straight, somewhat bracket-shaped; rachidian twice as long as broad, tapering to a single rather blunt cusp which just projects beyond the basal plate; laterals scarcely larger than the rachidian and of the same construction, angle of basal plate scarcely expanded, the more distant laterals grow slenderer and more inclined; two or three transition teeth intervene between the latter and the marginals, which are sinuate and bicuspidate. In the figure, the marginal teeth should be transferred from the right to the left of the centrals.

I lately hazarded a conjecture (Records Aus. Museum, Vol. i., p. 136) on the affinity of *N. hunsteini* to *N. sophiæ*, &c. The dentition here described does not support this view.

Genitalia (pl. xlii., fig. 39), penis sac long and cylindrical, with a globose sessile sac seated half way along it and another smaller

sac, to which the retractor muscle is affixed, at the summit; the spermatheca is at its apex boot-shaped, expanding after a constriction into a second globose sac, which communicates with the system by a short wide duct.

N. DIVISA, Forbes, var. INCLINATA, Pfr.

Jaw (pl. XL., fig. 20) smooth, wide, arched, with a deep beak-like projection inferiorly.

Radula (pl. XXXVIII., fig. 3) strap-shaped, three times as long as broad; formula 96 rows of 54 : 11 : 1 : 11 : 54; rachidian cusp large, ovate, considerably overlapping its basal plate, supplied at half its length with two accessory cusps; laterals one-third larger than the rachidian, inner accessory cusp lost, outer retained, outer angle of the basal plate alate; marginals unicuspidate, cusp in profile shaped like a rose-thorn, slender, inclined.

Genitalia (pl. XLII., fig. 38), penis sac large, dilated; spermatheca oval on a wide contorted duct.

Animal exhibiting a caudal mucous pore, pedal line and tail diagonally grooved.

MICROCYSTINA SAPPHO, Brazier.

Jaw (pl. XXXVIII., fig. 7) short, broad, flat, smooth, with a blunt median inferior projection, ends smooth.

Radula (pl. XXXVIII., fig. 4) ovate, narrow, three times as long as broad; formula 96 rows of 36 : 10 : 1 : 10 : 36; rachidian twice as long as broad, tricuspid, median cusp slender, lanceolate, overlapping the basal plate, auxiliary cusps seated half way along the reflection; laterals larger than the rachidian, median cusp narrow, sharp, considerably overlapping the basal plate, slightly inclined towards the rachidian, proximal accessory cusp rudimentary, distal one well developed; the marginals follow two or three transition teeth and are the shape of a scythe blade, the concave margin is apparently interrupted by an acccessory cusp, which on careful examination is seen to be the posterior angle of the triangular base of the adjoining tooth.

This dentition bears out the relationship claimed on shell characters with western species. Compare Godwin-Austen's account of the anatomy of *M. rinkii* from the Nicobars (Land and F. W. Moll. of India, p. 12, pl. III.).

Helicarion musgravei, Hedley.

Jaw (pl. xxxviii., fig. 9) short, wide, with a stout blunt median projection, ends emarginate.

Radula (pl. xli., fig. 30) oval, three times as long as broad, stained brown anteriorly; formula 128 rows of 45 : 18 : 1 : 18 : 45; rachidian bearing a slender lanceolate median cusp surpassing its basal plate and two well developed accessory cusps; laterals long, narrow, with a slender median cusp, which becomes longer and more inclined as the ranks retreat, proximal accessory cusp rudimentary, distal one well developed; transitional teeth four or five, marginals much inclined, cusp bicapitate.

Cristigibba macgregori, Hedley.

Jaw (pl. xxxviii., fig. 6) boomerang-shaped, smooth, ends truncated, no transverse ribs, inferior margin showing traces of denticulation, centre of the jaw closely longitudinally wrinkled.

Radula (pl. xxxix., fig. 12) strap-shaped, twice as long as wide; formula 110 rows of 26 : 20 : 1 : 20 : 26; rachidian two-thirds the size of the immediate laterals, with a stout square-headed cusp extending along three-fourths of the narrow basal plate; laterals also square-headed, very slightly inclined, alate angle of basal plate scarcely produced; marginals tricuspid.

Chloritis leei, Cox.

Jaw (pl. xxxix., fig. 15) arched, crossed by about eight stout flat-topped ribs, which denticulate either margin and are divided by narrow interstices, ends smooth, truncate.

Radula (pl. xxxix., fig. 13) strap-shaped, three times as long as broad, rows nearly straight; formula 167 rows of 40 : 17 : 1 : 17 : 40; rachidian unicuspidate, stout, linguiform, two-thirds the length of

its basal plate, which is twice as long as broad and slightly expanded posteriorly; immediate laterals rather larger, similar in shape, not attaining the basal margin, basal plate briefly alate, distant laterals longer and slenderer; marginals developing a proximal accessory cusp, which assumes a sabre-like aspect and increases in size as the ranks retreat; a distal accessory cusp is also added.

Genitalia (pl. XL., fig. 23) remarkable for the extremely long flagellum, which arises from a double knob at the summit of the slender subcylindrical penis sac.

C. CHLORITOIDES, Pilsbry.

Jaw (pl. XXXIX., fig. 17) boomerang-shaped, crossed by nine elevated ribs, which denticulate both margins, ends smooth, rounded.

Radula (pl. XL., fig. 22) narrow, strap-shaped, three times as long as broad; formula 127 rows of 24 : 11 : 1 : 11 : 24; rachidian unicuspidate, linguiform, extending more than half way along its basal plate; laterals rather larger, slightly inclined, developing a rudimentary distal accessory cusp, basal plate roughly a parallelogram; after four or five transition teeth the marginals show the main cusp cleft and the distal accessory cusp much developed.

With these species compare the anatomy of *C. porteri*, Cox (Proc. Roy. Soc. Q'land, Vol. vi., pl. xv.).

HADRA BROADBENTI, Brazier.

Jaw (pl. XXXIX., fig. 16) arched, boomerang-shaped, crossed by eleven flat-topped ribs, which denticulate both margins and are wider than their interstices, ends rounded, smooth.

Radula (pl. XLII., fig. 35) strap-shaped, twice as long as broad, rows bracket-shaped, bisinuate across the marginals; formula 160 rows of 57 : 12 : 1 : 12 : 57; rachidian two-thirds the size of the immediate laterals, cusp simple, linguiform, with a small cutting point, extending along three-quarters of its basal plate; immediate laterals similar in shape, the remoter ones longer and slenderer;

in the marginals the main cusp is cleft at its summit and an accessory cusp appears at its distal base.

Genitalia (pl. XLI., fig. 27), penis sac large and ovoid; spermatheca small, cylindrical, without terminal dilatation.

GEOTROCHUS BRUMERIENSIS, Forbes.

Jaw (pl. XLI., fig. 31) boomerang-shaped, central half crossed by about nine weak ribs, which denticulate either margin, ends smooth, angled.

Radula (pl. XXXVIII., fig. 8) tongue-shaped, twice as long as broad; formula 110 rows of 40 : 7 : 1 : 7 : 40; otherwise as in *G. boyeri.*

Genitalia (pl. XL., fig. 21), penis sac small, conical; vas deferens long and contorted; spermatheca oval on a long peduncle.

G. LOUISIADENSIS, Forbes.

Jaw (pl. XXXVIII., fig. 2) boomerang-shaped, centre crossed by half-a-dozen weak ribs denticulating both margins, ends smooth, rounded.

Radula (pl. XL., fig 24) tongue-shaped, twice as long as broad; formula 142 rows of 45 : 9 : 1 : 9 : 45; rachidian smaller than the immediate laterals, square-headed, extending along three-fourths of the basal plate, whose anterior angles are scarcely expanded; laterals large, square-headed, alate angle of the basal plate scarcely expanded: marginals tricuspid.

Genitalia (pl. XL., fig. 19), penis sac large, dilated and contracting suddenly; spermatheca oval on a large peduncle.

G. ROLLSIANUS, Smith.

Jaw (pl. XXXVIII., fig. 10) thin, arcuate, central quarter crossed by seven very delicate ribs, ends smooth, rounded.

Radula (pl. XLI., fig. 29) strap-shaped; formula 154 rows of 45 : 10 : 1 : 10 : 45; rachidian two-thirds the size of the immediate laterals, reflection slightly tapering, terminating in a single square-headed cusp, which does not reach the basal margin;

laterals with a large square-headed cusp ; after ten series a hook develops on the proximal side of the main cusp, which latter diminishes in size and divides into two or three cusps in the extreme marginals.

In the figure the marginal teeth should be transferred from the right to the left of the central.

G. WOODLARKIANUS, Souverbie.

Jaw (pl. XLI., fig. 28) low, boomerang-shaped, central third crossed by about half-a-dozen weak ribs with narrow interstices denticulating either margin, ends smooth, rounded.

Radula (pl. XLII., fig. 36) tongue-shaped, twice as long as broad; formula 130 rows of 42 : 9 : 1 : 9 : 42 ; rachidian about two-thirds the size of the immediate laterals, square-headed; laterals straight, square-headed, with the alate angle of the basal plate scarcely shown ; marginals trifid.

Genitalia (pl. XLI., fig. 32) closely resembling those of *trobriandensis*.

G. TROBRIANDENSIS, Hedley.

Jaw (pl. XXXVIII., fig. 5) slightly arched, central third crossed by half-a-dozen weak ribs and narrow interstices, which denticulate both margins, ends smooth, obtusely angled.

Radula (pl. XXXIX., fig. 14), formula 154 rows of 55 : 8 : 1 : 8 : 55; rachidian square-headed, projecting along three-fourths of the basal plate, rather smaller than the laterals, which are also square-headed, slightly sinuate, twice as long as broad, alate angle of basal plate slightly developed ; the marginals possess in addition to the main cusp a proximal falcate and a minute distal accessory cusp.

Genitalia (pl. XLII., fig. 33), penis sac slender, much contorted ; spermatheca ovoid on a long slender peduncle.

G. BOYERI, Fischer and Bernardi.

Jaw (pl. XLI., fig. 25), the central third narrow, crossed by half-a-dozen weak ribs with narrow interstices, ends smooth, rounded.

Radula (pl. xxxix., fig. 18), formula 104 rows of 33 : 6 : 1 : 6 : 33; rachidian cusp stout, ovate, two-thirds the size of the first lateral, extending along more than half of its basal plate; the cusp of the first lateral is large, oval, blunt, much inclined and equalling or surpassing the posterior margin of its basal plate, the succeeding laterals diminish in size; they are followed without any transition teeth by the marginals, which acquire a distal cusp in the same plane as the chief cusp and a falcate proximal cusp on a higher plane.

Genitalia (pl. xli., fig. 26), penis sac subcylindrical; spermatheca oval on a long peduncle.

Succinea simplex, Pfeiffer.

Jaw (pl. xlii., fig. 34) ribless, with a blunt median inferior projection, ends recurved.

Radula (pl. xlii., fig. 37) narrow, strap-shaped, three times as long as broad; formula 85 rows of 16 : 13 : 1 : 13 : 16; rachidian with basal plate twice as long as broad, slightly expanded posteriorly, reflection small, tricuspid, main cusp ovate, extending halfway along the basal plate, accessory cusps about half the size of the parent; laterals bicuspid, the proximal twice as long as the distal but shorter than the basal plate, which is emarginate on its posterior edge; one transition tooth is followed by minute marginals with trifid or quadrifid cusps.

Since writing the previous paper, several parts of the "Manual of Conchology" have appeared. Had I received them earlier, I should have profited by much additional information, and have replaced *Geotrochus* by *Papuina*, transferred *rehsei* and *beatricis* from *Hadra* to *Chloritis*, also *bevani*, *oxystoma* and *elisus* from *Geotrochus* to *Obba*, and reduced *tapparonei* to a synonym of *P. naso*, von Martens. I find that *S. gracilis*, Hutton, has several years' priority over *S. subula*, Pfr. (*ante*, pp. 98 and 557).

In alluding (*ante*, p. 100) to *S. simplex*, I expressed a doubt as to the correctness of the determination. Having requested Mr.

E. A. Smith, of the British Museum, to compare my Papuan specimens with Pfeiffer's types, I received from that gentleman the following courteous reply :—"The two specimens of *Succinea* from Mita, Milne Bay, are a trifle shorter than the types (3 specimens) of *S. simplex*, Pfr., and are more amber in colour, but they agree in the latter respect, and also in form, exactly with another series of specimens from Treasury and Shortland Islands, Solomon Group, which I identify as a form of *simplex*." Since the experiences of Mr. Brazier, Dr. Guppy, and myself agree in finding this mollusc in the taro gardens, it may perhaps be introduced with this vegetable from island to island.

I am also indebted to Mr. Smith for the information that my species *Helicina insularum (ante*, p. 113) is identical with *H. suprafasciata*, Sowerby (Conch. Icon. xix., HELICINA, pl. XXX., sp. 300), with whose types in the British Museum he has kindly compared my specimens. Sowerby's types were not collected, as stated, during the cruise of the "Curaçoa," but were received from an island trader by Mr. Brazier, who after the return of the "Curaçoa" forwarded them to Mr. Julius Brenchley, by whom they were presented to the national collection. That Sowerby assigned the species to "Australia" (!) I offer as a sufficient excuse for having overlooked his figure and description.

An inspection of specimens in the Australian Museum labelled *Cyclotus levis*, Pfeiffer, collected at Maru Sound, Guadalcanar, Solomon Archipelago, by Mr. Brazier, suggests that this name is synonymous with, and takes priority over, *C. tristis*, Tapparone-Canefri. This species (determined as *levis)* is described by Mr. Brazier as being everywhere abundant, and unlike any other shell known from the island. There can therefore scarcely be a doubt that the shells collected by MacGillivray during the cruise of the "Herald" in 1854, upon which Pfeiffer founded the species (P.Z.S., 1855, p. 118), are similar to those quoted as "Guadalcanar (MacGillivray in Brit. Mus.)" by Smith in the P.Z.S., 1885, p. 596. These he identifies with others collected in 1882 during the cruise of the "Lark" by Dr. Guppy at Faro, Shortland and Santa Anna Islands, and at Choiseul Bay in Bougainville Straits, Solomon

Archipelago. The chain of evidence is completed by the recognition (P.Z.S., *l.c.)* of Guppy's specimens as a variety of his *C. tristis* by Dr. Tapparone-Canefri, himself. I do not, however, understand why, if the preceding argument be correct, the learned conchologist of the British Museum failed to see Pfeiffer's species, of which he possessed the type, in the specimens labelled "Guadalcanar (MacGillivray)"; but the loss or displacement of a ticket has originated many such errors.

Other localities where this widespread and variable species has occurred to Mr. Brazier are—Rubiana, Solomons; Blanche Bay, New Britain; and Port Hunter, Duke of York Islands. After this review of specimens and descriptions, I have to plead guilty to adding a third name *(Leptopoma parvum; ante*, p. 111) to the synonymy of the species. The differences presented by the solitary shell I collected in Milne Bay from the figure and description published by Tapparone-Canefri, which alone I consulted, sink into insignificance after comparison with further specimens, figures and descriptions. Very close, if not identical with this species, must be the *C. novæ-hibernæ*, Pfeiffer.

In my former article I dealt with the internal distribution of the mollusca of the province whose divisions may be briefly summed up as alpine, insular and northern or southern of the axis of the Owen Stanley chain of mountains. A few remarks on the external relations of this fauna have since suggested themselves. Wallace's line, so conspicuous a severance among the vertebrates, appears to be quite blotted out when the distribution of animals is regarded from a molluscan standpoint. No sharp break occurs between the Malayan fauna as exemplified in Borneo or the Philippines and in New Guinea. All the characteristic Malayan forms, *Atopos*, *Xesta*, *Helicarion*, *Microcystina*, *Trochomorpha*, *Obba*, *Chloritis*, *Cochlostyla*, *Pupina* and *Diplommatina*, are common to both regions. The Solomon Islands, Fiji, Samoa, &c., appear by the light of the Papuan shells to be inhabited by an eastern extension of this Malayan fauna, which has also over flowed into Queensland.

One of the most remarkable facts yielded by an analysis of the Australian land molluscan fauna is that the operculate snails are confined to a narrow strip of land along the Queensland coast. Proceeding southwards from Torres Straits, they diminish gradually till the last outpost of the invading army is reached about the Clarence River.* The sole apparent exception to this rule is *Truncatella*, which spreads to Tasmania and South Australia; but as this genus is strictly littoral and evidently migrates not by land but by sea, it cannot be considered as a disturbing factor in my generalisation. Contrasting the fauna of Queensland with the more typically Australian and probably archaic fauna of Tasmania, Victoria and Western Australia on the one side, and that of New Guinea on the other, it will be seen that this foreign aspect of the operculate genera *Pupina*, *Helicina* and *Diplommatina* is shared by the inoperculate forms of *Atopos*, *Hadra*, *Chloritis* and *Papuina*; *A. prismaticus* of Papua claiming affinity with *A. australis* of Queensland; *H. broadbenti* with *H. informis*; *C. chloritoides* with *C. porteri*; and *P. naso* with *P. macgillivrayi*. The species actually common to both regions are few; *B. macleayi* inhabits both countries, *T. annula* only finds a place in the Queensland catalogue† by courtesy, while *P. pedicula*, *S. gracilis*, *T. ceylanica*, *T. valida*, and *L. vitreum* are widespread throughout Polynesia. From these premises it may be deduced that the Queensland mollusc fauna, though isolated sufficiently long to have lost specific identity with that of Papua, has nevertheless been derived from it.

The shallow sea of Torres Straits now severs this continent from the adjoining island. Were its bed raised but seven fathoms, the two countries would be united, while an elevation of ten fathoms would form a wide bridge between them. When the marine life east and west of Torres Straits is better known, it will be of interest to observe whether the influence of an ancient

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* The furthest straggler, so Mr. Brazier informs me, is *Helicina jana*, Cox, from Port Macquarie, N.S.W.

† Proc. Roy. Soc. Queensland, vol. v., p. 52.

isthmus is still visible in any divergence between the faunas inhabiting the two areas.

Further to the westward, the coasts of Australia and New Guinea again converge, being separated by an arm of the Arafura Sea, which gradually shoals from a central depth of 40 fathoms, and stretches for about 150 miles between Cape Wessel in the northern territory and Cape Valsche on the opposite shore of Dutch New Guinea.

In the Transactions of the Royal Society of S. Australia, Vol. v., pp. 47-56, Professor Tate enumerates the land and freshwater mollusca of tropical S. Australia; it is remarkable that whereas a third of the landshells of Papua and a sixth of the landshells of Queensland are operculate, his census includes no operculate landshells whatever. Thus at the remote date when the ancestors of the present Queensland mollusc fauna migrated from New Guinea across the ancient isthmus that I suppose to have bridged Torres Straits, the Arafura Sea appears to have still presented an impenetrable barrier between the two countries. The former elevation of land in this region, if uniform from east to west, may therefore be calculated at more than seven and less than forty fathoms.

EXPLANATION OF PLATES.

Plate xxxviii.

Fig. 1.—Jaw of *N. hunsteini*. Magnified.

Fig. 2.—Jaw of *G. louisiadensis*. Magnified.

Fig. 3.—Two rows of seven teeth from the centre, and of the eighteenth to the twenty-second from the margin, of the radula of *N. divisa*, var. *inclinata*. Much magnified.

Fig. 4.—Two rows of thirteen teeth from the centre, and of the twenty-fifth to the thirtieth from the margin, of the radula of *M. sappho*. Much magnified.

Fig. 5.—Jaw of *G. trobriandensis*. Magnified.

Explanation of Plates *(continued)*.

Fig. 6.—Jaw of *C. macgregori*. Magnified.

Fig. 7.—Jaw of *M. sappho*. Magnified.

Fig. 8.—Two rows of seven teeth from the centre, and of the forty-second to the forty-fifth from the margin, of the radula of *G. brumeriensis*. Much magnified.

Fig. 9.—Jaw of *H. musgravei*. Magnified.

Fig. 10.—Jaw of *G. rollsianus*. Magnified.

Plate xxxix.

Fig. 11.—Two rows of eleven teeth from the centre, and of the twenty-second to the twenty-sixth from the margin, of the radula of *N. hunsteini*. Much magnified.

Fig. 12.—Two rows of eleven teeth from the centre, and of the twenty-seventh to the thirty-first from the margin, of the radula of *C. macgregori*. Much magnified.

Fig. 13.—Two rows of thirteen teeth from the centre, and of the twenty-second to the twenty-sixth from the margin, of the radula of *C. leei*. Much magnified.

Fig. 14.—Two rows of eleven teeth from the centre, and of the twenty third to the twenty-sixth from the margin, of the radula of *G. trobriandensis*. Much magnified.

Fig. 15.—Jaw of *C. leei*. Magnified.

Fig. 16.—Jaw of *H. broadbenti*. Magnified.

Fig. 17.—Jaw of *C. chloritoides*. Magnified.

Fig. 18.—Two rows of eleven teeth from the centre, and of the eighteenth to the twenty-first from the margin, of the radula of G. *boyeri*. Much magnified.

Plate xl.

Fig. 19.—Genital system of *G. louisiadensis*.

Fig. 20.—Jaw of *N. divisa*, var. *inclinata*. Magnified.

Fig. 21.—Genital system of *G. brumeriensis*.

Fig. 22.—Two rows of fifteen teeth from the centre, and of the twenty-second to the twenty-sixth from the margin, of the radula of *C. chloritoides*. Much magnified.

EXPLANATION OF PLATES *(continued)*.

Fig. 23.—Genital system of *C. leei*.

Fig. 24.—Two rows of nine teeth from the centre, and of the twenty-third to the twenty-seventh from the margin, of the radula of *G. louisiadensis*. Much magnified.

PLATE XLI.

Fig. 25.—Jaw of *G. boyeri*. Magnified.

Fig. 26.—Genital system of *G. boyeri*.

Fig. 27.—Genital system of *H. broadbenti*.

Fig. 28.—Jaw of *G. woodlarkianus*. Magnified.

Fig. 29.—Two rows of nine teeth from the centre, and of the forty-eighth to the fifty-first from the margin, of the radula of *G. rollsianus*. Much magnified.

Fig. 30.—Two rows of eleven teeth from the centre, and of the twenty-second to the twenty-sixth from the margin, of the radula of *H. musgravei*. Much magnified.

Fig. 31.—Jaw of *G. brumeriensis*. Magnified.

Fig. 32.—Genital system of *G. woodlarkianus*.

PLATE XLII.

Fig. 33.—Genital system of *G. trobriandensis*.

Fig. 34.—Jaw of *S. simplex*. Magnified.

Fig. 35.—Two rows of eleven teeth from the centre, and of the thirty-fourth to the thirty-eighth from the margin, of the radula of *H. broadbenti*. Much magnified.

Fig. 36.—Two rows of eleven teeth from the centre, and of the seventeenth to the twentieth from the margin, of the radula of *G. woodlarkianus*. Much magnified.

Fig. 37.—Two rows of eleven teeth from the centre, and of the nineteenth to the twenty-second from the margin, of the radula of *S. simplex*. Much magnified.

Fig. 38.—Lower portion of the genital system of *N. divisa*, var. *inclinata*.

Fig. 39.—Genital system of *N. hunsteini*.

ERRATA.

Pl. III.—Fig. 5 is incorrectly described as "of natural size"; it should be "$\times 1\frac{1}{2}$."

Page 71, line 29—*for* * *read* †.

Page 80, line 11—*to description add* Nature, Dec., 1890. p. 115.

Page 80, line 34—*after* I found in company *add* with.

Page 85, line 29—for *Helix Goldei* read *Helix Goldiei.*

Page 86, line 4—*after* goldiei, Brazier, *add* 1885.

Page 93—*to habitats add* Douglas River (Bevan).

Page 99, line 15—*to anatomy add* Proc. Ac. N.S. Phil., 1875, pl. XV., fig. 8, and pl. XVI., fig. 1.

Page 99, line 21—for TORNATELLINA TERESTRIS read TORNATELLINA TERRESTRIS.

Page 107, line 24—*for* antepenultimate *read* penultimate.

Page 108—*to* 94 *add* †.

Page 111, line 8—*for* penultimate whorls *read* penultimate whorl.